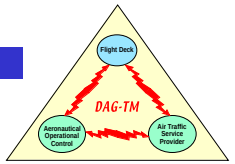
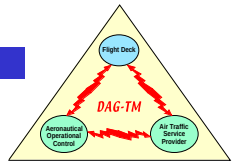


DAG-TM
Operations Concept
and Others

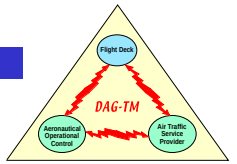
Del Weathers NASA/ARC
AATT Project

OPSCON “GAP Analysis”

Outline



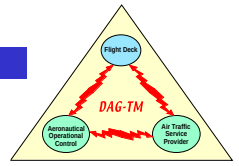
- DAG-TM OPSCON Effort
- Operational Needs Statements by Source (RTO-35)
- Free Flight Definition
- Scope of Free Flight Operational Concepts
- DAG-TM Vision Statement
- Scope of DAG-TM Concept (2 pages)
- DAG-TM Concept Definiton Outline
- Detailed Descriptions of DAG-TM
- Summary
- Backup Slides
  - OPSCON and Supporting Content (2 pages)
  - NASA's Effort to Support Free Flight
  - RTCA's Free Flight Task Force 3
  - FAA's OPSCON for 2005
  - FAA Architecture 4.0



AATT DAG-TM OPSCON Effort

- Provide expertise for sustaining DAG-TM OPSCON
  - AATT Project Controlled Document
    - Baselined Oct/99 (Milestone 8.5.1)
    - Prepared by DAG-TM Team members
  - Task: Examine Concept
    - Assess Compatibility with other OPSCONs
    - Assess Completeness and Consistency
  - Task: Review and Update as Required
    - Part of DAG-TM Team Effort
    - NRA-TO 41 (DAG-TM Detailed Descriptions)
- Integrate DAG concepts into overall AATT OPSCON
  - Task: NRA-TO 42 (Update AATT OPSCON)

Operational Needs Statements by Source (RTO-35)



• AATT97 - Milestone 1.0.0	738
• ATS Concept of Operations for NAS in 2005 - Narrative	22
• Addendum 1: Operational Tasks & Scenarios	21
• Joint Government-Industry Operational Concept (RTCA)	31
• NAS Architecture 4.0	36
• Safe Flight 21 Functional Specification	9
• ATS Concept of Operations for NAS Mature State (MITRE)	12
• ATS Performance Plan for FY 1998-2000	5
• ATM Strategy for 2000+, Vol. 2	4
• DAG TM Concept Definition	16
• Constrained En Route Airspace Problems (RTO-7)	2
• Multi-Facility TMA Requirements (RTO-16)	2
• Assessment of R&D Efforts - Future Op Concepts (RTO-23)	16
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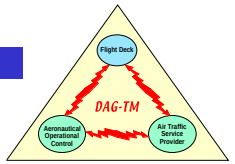
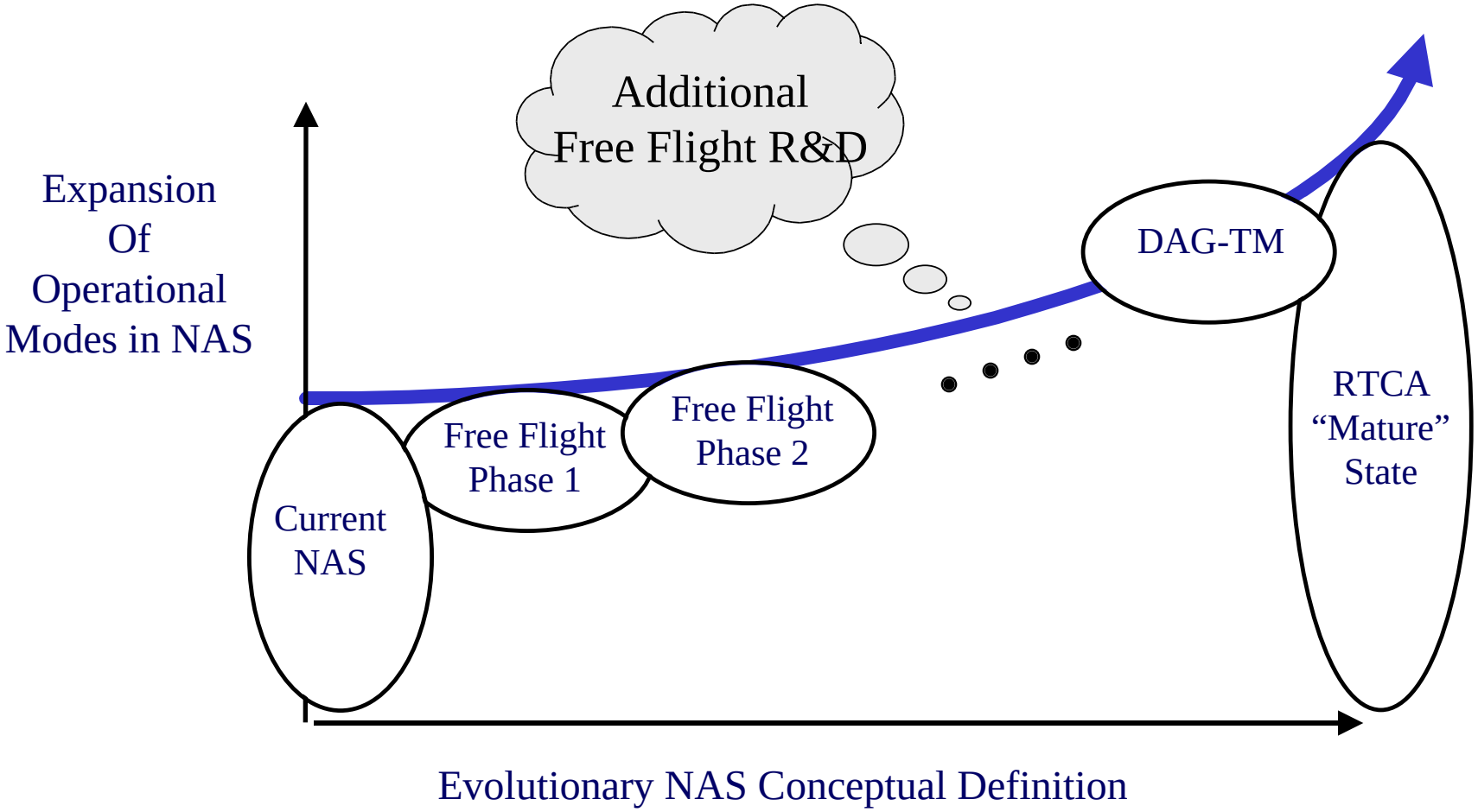


Free Flight Definition

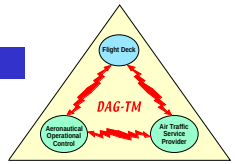
Free Flight is "a safe and efficient flight operating capability under instrument flight rules (IFR) in which the operators have the freedom to select their path and speed in real time. Air traffic restrictions are only imposed to ensure separation, to preclude exceeding airport capacity, to prevent unauthorized flight through Special Use Airspace (SUA), and to ensure safety of flight. Restrictions are limited in extent and duration to correct the identified problem. Any activity which removes restrictions represents a move toward free flight."

RTCA Select Committee on Free Flight, 1995

Scope of Free Flight Operational Concepts



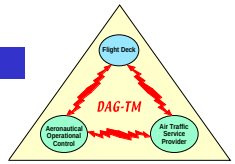
DAG-TM Vision Statement



"Distributed Air/Ground Traffic Management is a National Airspace System concept in which flight deck (FD) crews, air traffic service providers (ATSP) and aeronautical operational control (AOC) facilities use distributed decision-making to enable user preferences and increase system capacity, while meeting air traffic management requirements.

DAG-TM will be accomplished with a human-centered operational paradigm enabled by procedural and technological innovations. These innovations include automation aids, information sharing and Communication, Navigation, and Surveillance (CNS) / Air Traffic Management (ATM) technologies."

Scope of DAG-TM Concept (1 of 2)

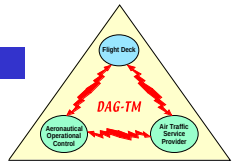


DAG-TM is a proposed concept for gate-to-gate NAS operations beyond the year 2015.

It will address dynamic NAS constraints such as bad weather, Special Use Airspace (SUA) and arrival metering/spacing.

The goal of DAG-TM is to enhance user flexibility/efficiency and increase system capacity, without adversely affecting system safety or restricting user accessibility to the NAS.

Scope of DAG-TM Concept (2 of 2)

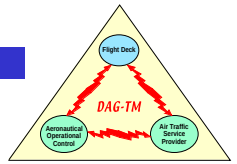


The DAG-TM concept is intended to address all user classes (commercial carriers, general aviation, etc.) with an emphasis towards ensuring access to airspace resources for the entire user community.

It covers all flight phases (Pre-Flight Planning, Departure, Cruise and Arrival) and operational domains in the NAS (Surface, Terminal Airspace and En route Airspace).

Although other operational domains (e.g., European, oceanic, and under-developed airspace) are outside the scope of the current DAG-TM concept, research activities will give due consideration to global interoperability issues.

DAG-TM Concept Definition Outline



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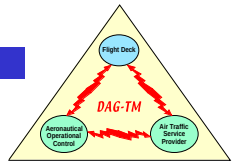
Detailed Descriptions of DAG-TM



The primary purpose of NRA/Research Task Order (RTO)-41 is to develop and document detailed descriptions of four concept elements (CE 5, 6, 7 & 11)

Descriptions will be key documents for AATT research and development activities

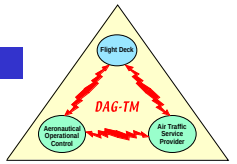
Developed in sufficient descriptive detail to

- Support experimental research activities and
- Initial high-level human factors, benefits and safety analyses

Two secondary purposes are:

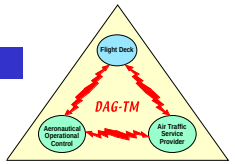
1. Create overview for the four DAG/TM concept elements that can be inserted into the overall AATT OPSCON work (NRA/RTO-35 and RTO-42)
2. Map possible transition paths for each concept elements from current or near-term envisioned operations to mature-state DAG-TM operational concept

50 COPIES of SOW available



Summary

- DAG-TM Workshop Papers for Operational Concept and Others
  - "Introduction to Avalanche Theory" — Phillip Goetz/IAI
  - "Stability & Performance of Intersecting Aircraft Flows Under Decentralized Conflict Avoidance Rules" — Eric Feron/MIT
  - "Wind Error Modeling" — Bill Colligan/CSSI
  - "System Architecture" — Steve Bradford/FAA
  - "Agents for Distributed Systems" — Leonard Haynes/IAI
  - "FAA's Safe Flight 21" — Oscar Olmos/MITRE



OPSCON BACKUP SLIDEs

OPSCON and Supporting Content (1 of 2)

- Categorization of OPSCON content by
  - Functions + Human Factors
  - Phases of Flight

C - comm
N - nav
S - surv
W - weather
A - automation
M - maint/facil
H - human factors

1 - intro
2 - flight planning
3 - surface
4 - arr/dep
5 - en route
6 - oceanic
7 - NAS mgt
8 - mgt

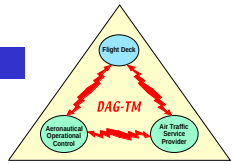
	DOC	IDEA	PAGE	OPS CON and SURROUNDING (SUPPORTING) CONTENT	KEYWORDS	C	N	S	W	A	M	H	1	2	3	4	5	6	7	8
X	DAG	User Dependence on Service Providers	vi, 10	***Decreased user dependence upon Air Traffic Service Provider services and a ground-based infrastructure***	User Dependence	C	N	S	W	A	M			2	3	4	5	6		
X	DAG	Flying Public	1	***the flying public and private sector will directly benefit from reduced transportation costs and increased schedule/connectivity.*** T***he general public will indirectly benefit from the resulting economic growth (national productivity and gross national prod***	Flying Public								1							
X	DAG	Cultural issues	3	***"Cultural" issues regarding the introduction of new technologies (DSTs), procedures and roles/responsibilities; e.g., operational training and pilot/controller acceptance.***	Pilot/Controller Acceptance								1							
X	DAG	Distributed Decision-Making between the ATSP-FD-AOC triad.	5	***Successful implementation of the ... will require an unprecedented level of distributed decision-making between the components of the Air Traffic Service Provider, ...Flight Deck, ... Aeronautical Operational Control triad.***	Distributed Decision-Making between the ATSP-FD-AOC triad.	C				A			1							
X	DAG	Integration of Technology	5	***... high level of distribution will ... necessitate a high level of integration between airborne and ground-based systems and tools such as decision support automation, datalink applications, and CNS/ATM technologies.***	Integration					A	M		1							
X	DAG	Direct Operating Cost Sharing	9	***The most obvious user benefit is a reduction in the per-flight direct operating cost that every user operating under IFR can obtain through real-time optimization of their flight trajectory.***	Direct Operating Cost Sharing					A	M		1						7	

OPSCON and Supporting Content (2 of 2)

X	DAG	Distribution of the Cost for NAS Modernization	10	***...benefit is the distribution of the cost for NAS modernization. The cost is shared by the users to a greater extent.***	Distribution of the Cost for NAS Modernization						M		1									
X	DAG	Cost of Equipment	v	***Users make business decisions on equipage level based on their cost/benefit assessments.***	Cost of Equipment						M		1									
X	DAG	Equipage Level and Increase	12	***every aircraft in the NAS will obtain some benefits regardless of their equipage level, with the level of benefits increasing as the level of equipage increases.***	Equipage Level and Increase						M		1									
X	DAG	DST equipment designed, and accompanying procedures established	17	***DST equipment will be designed, and accompanying procedures established, in a manner that will maintain workloads at a comfortable level for all parties, while ensuring that the decision-making process is timely and intuitive.***	DST; Procedures					A	M									7		
X	DAG	4D weather information	18	***... 4D weather information (winds, temperature, turbulence, storm cells, icing, etc), combined with analysis of trajectory predictions to determine the flights that are possibly affected, will allow users (FD / AOC) to more effectively plan and re-plan va***	4D weather information			S	W	A				2		4	5	6				
X	DAG	User-ATSP exchange of state and intent	18	***User-Air Traffic Service Provider exchange of state and intent data will improve the accuracy of, and consistency between, FMS and ground-based trajectory predictions.***	User-ATSP exchange of state and intent	C	N	S		A				2	3	4	5	6	7			

X	DAG	Departure Path; Climb Profile	21	***Appropriately equipped aircraft are given authority to select departure path and climb profile in real time, along with the responsibility to ensure separation from local traffic.***	Departure Path Climb Profile	C	N	S		A				2	3	4						
X	DAG	Properly equipped aircraft maneuver as necessary to avoid weather cells, or to follow such aircraft using self-spacing procedures.	32	***Properly equipped aircraft are given authority to maneuver as necessary to avoid weather cells, or to follow such aircraft using self-spacing procedures.***	Maneuver as necessary; avoid weather cells; Self-spacing procedures		N	S								4						Needs to be applied to departure and arrival: already appears in AATT97 En Route page 43
X	DAG	Appropriately equipped aircraft are given clearance to merge with another arrival stream, and/or maintain in-trail separation relative to a leading aircraft.	34	***Appropriately equipped aircraft are given clearance to merge with another arrival stream, and/or maintain in-trail separation relative to a leading aircraft.***	Merge; Arrival stream; Maintain in-trail separation	C	N	S								4						
X	DAG	Appropriately equipped aircraft conduct closely-spaced independent approaches	36	***Appropriately equipped aircraft may conduct closely-spaced independent approaches by utilizing surveillance data, on-board avionics and new air-ground procedures to ensure safe separation.***	Independent Approaches		N	S							3	4						

NASA's Effort to Support Free Flight



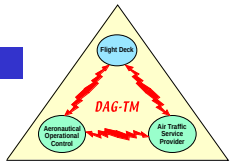
As part of the AATT project, NASA is conducting research efforts to support the RTCA Free Flight initiative

Free Flight Phases 1 and 2 Tools

DAG-TM R&D

This effort is founded on

- RTCA Free Flight OPSCON (Task Force 3) document +
- FAA's OPSCON 2005
- FAA's Architecture 4.0



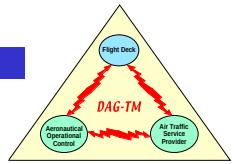
RTCA's Free Flight Task Force 3

"For 2005, the concept describes the next incremental steps towards Free Flight…The Mature State captures more advanced concepts and capabilities, such as self-separation"

"Separation assurance remains the responsibility of the service provider. However, that responsibility is shifted to the flight deck for specific operations"

[from Section 1.4 *The Evolution of NAS*]

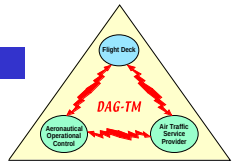
FAA's OPSCON for 2005



"As a result of the new systems in place in 2005…air safety has been increased through implementation of conflict detection and resolution tools, the inclusion of the flight deck in some separation decision-making, and greatly enhanced weather detection and reporting capabilities" (Narrative, Pg. 2)

"Separation assurance remains the responsibility of the service provider. However, that responsibility is shifted to the flight deck for specific operations" (Narrative, Pg. 2)

FAA's Architecture 4.0



"Modernizing the NAS will involve technology and cost risks. Some of the technologies…have not been tested in a operational environment…aircraft air-air separation…[will] require testing and validation prior to implementation" [§2.6]

"The essential focus is the Free Flight vision of a future NAS that permits users to fly without the constraints…this shift will be made possible by decision support tools for controllers, an enhanced pilot role in separation assurance using advanced cockpit avionics, use of space-based navigation aids, and use of a dynamic collaborative decision-making process" [§4.9]